SESSION 11 – Navigation and Information Systems II

Ship Performance Measurements – Houston Ship Channel, Galveston Bay, Texas

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PROJECT DESCRIPTION:

Study Purpose**.** The purpose of the study was to record and document data that defines ship motions (both horizontal and vertical) during transits in the Houston Ship Channel, particularly the Galveston Bay reaches, and the relevant environmental and ship control factors that influence these ship motions. These measurements combined with ship characteristics and channel conditions will provide data that can be used to better understand ship behavior and controllability in confined waterways and to verify numerical ship models. Since the ships measured will be operating through both a 400-ft x 40-ft channel and a 540-ft x 45-ft channel, these measurements will provide comparative data in two channel sizes. The results will be useful for improving the safety of present and future operations in the Houston Ship Channel. No special analysis of these data is included in this effort.

Basic Approach**.** The collection of accurate position (vertical and horizontal) data on ships in Galveston Bay from Barbers Cut to the intersection with the Gulf Intracoastal Waterway was the focus of this study. In addition, hydrographic data, water level, wind, and ship descriptive parameters, controls, and maneuvering characteristics were collected. From these data, ship tracklines, sinkage, and trim were computed. All records, data (both raw and reduced) and notes were organized and have been made available in Microsoft Excel worksheets in order to prepare for further analysis of these data in future studies.

Ships Measured**.** Twenty-five ships were measured during this project between July 16 and July 31, 2001. The ships measured are shown in the figure below. Included are the ship's principle characteristics and pertinent information about the ship data collected. These ships included 13 tanker/bulk carriers, 9 containerships, 2 OBO ships, and 1

general cargo ship. Eleven of the ships had beams greater than 129 ft. Of the nine meeting situations that were accomplished with both ships instrumented, four had a combined beam less than 212 ft and five had combined beams of greater than 240 ft. Five of the transits had survey boat water level measurements. Seven of the transits had velocity measurements taken at the specified cross-sections.

PROGRESS TO DATE: First phase of the study is complete and a draft report is available entitled as the project title and dated July 10, 2001.

FUTURE PLANS: Proposals will be prepared to evaluate this data. A proposal has been submitted to SNAME to develop a procedure for evaluating ship controllability. The data is available for others to use in research.

PRODUCTS: A draft report is available that contains a CD-ROM with all the data.

Predictive Tools for Underkeel Clearance

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PROJECT DESCRIPTION:
Problem Statement. The next generation of ships will require deeper drafts and more costly dredging to maintain coastal entrance channels to insure safe navigation. Underkeel Clearance (UKC) is the required minimum distance between the ship's keel and the bottom of the channel. The UKC is a function of the ship size and hydrodynamic characteristics, the channel cross-section and shape, and the ship speed. Since every foot of dredging costs millions of dollars, considerable savings can be realized if the UKC can be safely reduced.
Objective. In FY98 the Coastal and Hydraulics Laboratory began a program to improve the UKC requirements through a series of field and laboratory measurements of 6 degree of freedom (DOF) ship motions for a range of entrance channel configurations, ship, and wave conditions. Field data was collected for a variety of ships in the entrance channels at Barbers Point, HI, and Charleston, SC, using Global Positioning Systems (GPS). The field data is being used to validate our physical modeling and define any scale effects. Laboratory data was collected in a 1:75 scale of the Barbers Point entrance channel and harbor using a state-of-the-art motion analysis system (MOTAN) of accelerometers and angular rate sensors for surge, sway, heave, roll, pitch, and yaw. The goal of this data collection is to use this information to validate a design tool for predicting UKC for different wave, ship, and channel combinations. This data and model will be used to validate the Corp's ship simulator in a future study to improve its performance.
Impact/Payoff: The goal of this data collection is to use this information to validate analytical and numerical models for predicting UKC for different wave, ship, and channel combinations. This data and model will also be used with the Corp's ship simulator to improve its performance.

PROGRESS TO DATE: Field and laboratory underkeel clearance (UKC) data have been collected and are being compared. Initial steps have been taken to adapt the Navy's UKC deterministic prediction model for Army Corps use with commercial shipping. This modified code will provide input for a probabilistic model. A deterministic model is good for the conditions specified. A probabilistic model can be used to account for the uncertainty in the combination of ship speed, bottom bathymetry, ship transit, water depth, waves, and currents that might occur for a given ship transit through an entrance channel. Work has begun on determining the optimum statistical approaches for analysis of the laboratory and field UKC data.

This paper will summarize the data collection, analysis, and comparison of the UKC data from the field and laboratory data. The status of the deterministic prediction tool will be briefly summarized (it will be presented in more detail in a companion paper). Finally, the plans for future development and collaboration in the development of the probabilistic model will be presented.

FUTURE PLANS: The ultimate goal of this work unit is to provide predictive tools for predicting UKC for a range of harbors, entrance channel, ship, and wave and current conditions.

PRODUCTS: A user-friendly predictive model of UKC for a variety of ship types, entrance channel, and environmental conditions.

Next Generation Navigation Aids Research (NGEN NAV)

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PROJECT DESCRIPTION:

Problem Statement: Many studies have shown that radio navigation and electronic charting technologies can provide mariners with a more timely and precise position fix than traditional visual navigation and chart plotting. For a variety of reasons this single benefit of accuracy has not been enough of a driver to cause these tools to become a primary means of navigation. Surveys and discussions with mariners indicate that most still rely on visual aids to navigation.

The Coast Guard, under a Code of Federal Regulations mandate, has traditionally maintained buoys, lights, and beacons to provide a means for safe transit. The Coast

Guard also serves mariners with long-range radio navigation signals for harbor and harbor approaches. Examples of these services are the terrestrial based Loran C broadcast and the National Differential GPS radio broadcasting system which supplements the Department of Defense's GPS signals. This layering of systems could eventually cause resource problems for the Coast Guard. Risk management and customer relations precludes us from dis-establishing short range aids in the near term. But we could contemplate less costly waterway marking strategies in the future if we had a fuller understanding of new navigation paradigms that technology changes are beginning to yield.

Objective: The Coast Guard needs to determine what factors, if any, will cause society in general and mariners in particular to recognize that technology solutions could provide safer and more predictable means of navigating than practices of the past. If these factors can be identified, then the agency needs to know how they can be influenced and managed (i.e. training programs, public safety announcements, regulations, etc.), what impacts they will make on traditional Coast Guard missions, and, some prediction of when these impacts might take place.

Impact/Payoff: If successful the Coast Guard will be properly positioned in the future to execute its mandate to make provisions for safe and efficient passage on our nation's waterways. By participating in and shaping the process of technology adoption the Coast Guard will avoid finding itself in a reactive mode when requesting resources for the future. Emerging technologies will require their own infrastructure and support. This new work could be examples of tomorrow's Coast Guard missions.

PROGRESS TO DATE: Research on how mariners are presently using short range aids to navigation and navigational aids is ongoing. An extensive survey and study was recently completed in the Port of Tampa Bay. A report of the results is being issued. A Small Business Innovative Research (SBIR) contract was used to investigate Augmented Reality Aids to Navigation System concepts. The final report is available through DOT's SBIR program. Another project has studied the aids to navigation program's costs.

FUTURE PLANS: The project plans to investigate the use of technology roadmaps to help the Coast Guard plan and manage technology transfer in the marine domain. We also plan to make use of dynamic systems modeling to portray how technology transfer is likely to occur and what affect it will have on Coast Guard missions. The models will be used as marketing products along with position and technical papers to help build a senior management consensus on the Coast Guard's future policies regarding aids to navigation. Research will be conducted to identify key needs and gaps with regard to technology and full electronic navigation. This work will include study of information technologies, location intelligent information systems, the potential of wireless delivery solutions in the coastal zone, and, research of integrated information systems solutions and augmented reality displays.

PRODUCTS: The project will produce internal Coast Guard documents and prototype software models of technology transfer.

Integrated Marine Communications - A Tool to Improve Vessel Management

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PROJECT DESCRIPTION: The absence of reliable, economical, communications to the maritime community has resulted in inefficient management of both the nations transportation fleet and its waterways.

The conception, design, construction, and implementation of an integrated voice, data and vessel tracking communications network will provide significant benefits to all segments of the MTS – vessel owners, operators, and public agencies.

MariTEL conceived the MariTEL Network in the 1990's. The design was completed in 2001. Construction began in 2000, with Operational Testing and Evaluation completed in the spring of 2001. Full build-out of the Network in the continental 48 states will be completed by the end of 2002.

The Network will support automatic voice and data calling from ship-to-shore, shore-to-ship, and ship-to-shore-to ship. A Network scrambling protocol will make both sides of calls private. Vessels will be tracked using Digital Selective Calling (DSC) Position Reports (a call type supported by DSC).

Automated Commercial Environment (ACE): Business and Technology Benefits

PRINCIPAL INVESTIGATOR
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ABSTRACT:
The Automated Commercial Environment (ACE) is Customs first major modernization project. Through ACE, Customs will process imports more efficiently and that means moving goods through the ports and on to market faster and at lower cost. The trade community will also be able to process its business with Customs primarily electronically with paper held to a minimum.

The current Automated Commercial System (ACS) simply will not meet the increasingly complex, long-term requirements mandated by the growth in trade and Customs enforcement responsibilities. Customs ability to meet its objectives depends heavily on successfully modernizing its business functions and the information technology (IT) that supports those functions. Together through ACE, Customs and the Trade will use technologies such as the internet, frame relay and wireless communications to replace time-consuming and labor-intensive transactions with improved business processes. These processes will include:

- Remote filing
- Consolidated statements and periodic payment
- Reduced data entry
- Streamlined automated manifests
- National account management
- Streamlined billing, collections, refunds, quota and duty filings

ACE will also support better targeting and more efficient detection by leveraging technology such as relational databases, non-intrusive inspection, data mining and mass storage devices, digital imaging and digital forensics.

When ACE is fully deployed, all service ports will be able to participate in an integrated, fully automated information system. Import and export data will be effectively collected, analyzed and distributed. And the Trade community will experience the benefits of nationwide account-based processing.